What is claimed is:

1. An optical head for near-field recording and reproduction, comprising:

a slider which hovers above a recording medium by air dynamic pressure;

a light device module formed on a surface of the slider which faces the recording medium, the light device module comprising:

a vertical cavity surface emitting laser (VCSEL) which emits light toward the recording medium, and

a photodetector which detects the light emitted from the VCSEL and then reflected by the recording medium;

a first lens layer deposited on the light device module using a transparent material, the first lens layer comprising a first lens which condenses incident light at a portion corresponding to a light emitting portion of the VCSEL; and

an optical path control layer having a hologram at the center thereof, which controls the traveling path of incident light such that the light incident from the VCSEL through the first lens layer travels toward the recording medium, and the light reflected by the recording medium travels toward the photodetector,

wherein the VCSEL comprises:

a doped first distributed Bragg reflector (DBR) formed by alternately stacking layers of semiconductor materials having different refractive indexes,

an active layer formed on the first DBR, and

a second DBR doped with a type opposite to the doping of the first DBR, the second DBR formed by alternatively stacking semiconductor materials having different refractive indexes, wherein the VCSEL emits the light through a window of the second DBR.

2. The optical head of claim 1, wherein:

the hologram of the optical path control layer has a concentric pattern, and

the photodetector has an annular shape, which surrounds the VCSEL, and is formed in combination with the VCSEL.

3. The optical head of claim 2, wherein the VCSEL further comprises:

a first electrode between the slider and the first DBR, and

a second electrode formed in a predetermined pattern on the second DBR to expose the window of the second DBR; and

the photodetector comprises:

a first semiconductor material layer at least a portion of which is separated a predetermined distance from the VCSEL,

a second semiconductor material layer which absorbs light and is formed on the first semiconductor material layer,

a third semiconductor material layer formed on the second semiconductor material layer,

a first detecting electrode electrically connected to a portion of the first semiconductor material layer, and

a second detecting electrode formed in a predetermined pattern on the third semiconductor material layer to expose a light receiving surface of the third semiconductor material layer.

4. The optical head of claim 3, wherein the first semiconductor material layer of the photodetector has the same structure as the combined layers of semiconductor material of the first and second DBRs of the VCSEL, and a portion of the first semiconductor material layer above a predetermined layer of the first DBR is separated from the VCSEL.

5. The optical head of claim 3, wherein the second semiconductor material layer of the photodetector is formed of substantially the same material as that used to form the active

layer to have substantially the same thickness as the active layer, and the third semiconductor material layer of the photodetector is formed of substantially the same material as that used to form the first DBR to include a smaller number of layers than the first DBR.

6. The optical head of claim 1, wherein the hologram of the optical path control layer has a stripe pattern, and the photodetector is arranged at one side of the VCSEL.

7. The optical head of claim 1, wherein the first lens of the first lens layer is formed by diffusion-limited etching to have a predetermined curvature.

8. The optical head of claim 1, wherein the VCSEL emits the light having a wavelength of about 650 nm or 680 nm, and the first lens layer is formed of InGaP.

9. The optical head of claim 1, further comprising a second lens layer formed at a side of the optical control layer which faces the recording medium, the second lens layer formed of a material having a high refractive index and comprising a second lens for condensing incident light from the VCSEL.

10. The optical head of claim 9, wherein the second lens layer is formed of a material having a refractive index of about 2.1 or more.

11. The optical head of claim 1, further comprising:

a coil member formed on the first lens layer, the coil member comprising:

at least one coil layer having a spiral structure and a central opening, and

at least one insulating layer which protects a respective one of the at least one coil layer and electrically insulates the adjacent portions of each respective coil layer, the insulating layer formed of a transparent material to allow transmission of light through the central opening of each coil layer, the coil member enabling the recording of information on the recording medium by magnetic field modulation.

12. The optical head of claim 11, wherein the hologram of the optical path control layer is a polarization hologram having a high transmittance with respect to light polarized in a first direction and a high diffraction efficiency with respect to the light polarized in a second direction, and the optical path control layer further comprises a polarization changing layer at the side of the optical path control layer which faces the recording medium, to change the polarization of incident light.

13. The optical head of claim 11, wherein a plurality of coil layers are formed and the optical path control layer is located between two of the plurality of coil layers.

14. A method of manufacturing an optical head for near-field recording and reproduction, comprising:

preparing a substrate;

forming a light device module on the substrate, the light device module comprising:

a vertical cavity surface emitting laser (VCSEL) which emits light, and

a photodetector which receives light incident after having been emitted from the VCSEL and reflected by the recording medium;

forming a first lens layer by depositing a light transmitting material over the light device module, the first lens layer having a first lens, which condenses incident light, at a portion corresponding to a light emitting portion of the VCSEL; and

forming an optical path control layer having a hologram at the center thereof, to transmit light incident from the VCSEL through the first lens layer toward the recording medium, and to transmit light incident after having been reflected from the recording medium toward the photodetector.

15. The method of claim 14, wherein the forming of the first lens layer having the first lens comprises:

depositing the first lens layer over the light device module using the transparent material which transmits the light emitted from the VCSEL;

forming an etching mask having an opening over the first lens layer, the opening being at a portion corresponding to the light emitting portion of the VCSEL;

immersing the first lens layer with the etching mask in a chemical etching solution, such that a portion of the first lens layer exposed through the opening is etched by diffusion-limited etching, thereby resulting in the first lens with curvature; and

removing the etching mask.

16. The method of claim 14, further comprising:

forming the hologram of the optical path control layer to have a concentric pattern,

forming the photodetector to have an annular shape surrounding the VCSEL; and

forming the photodetector in combination with the VCSEL.

17. The method of claim 16, wherein the forming of the light device module comprises:

forming a first electrode on the substrate;

forming a stack of semiconductor material layers for the VCSEL and a first semiconductor material layer for the photodetector which are partially separated by a predetermined distance from each other, each of the stack for the VCSEL and the first semiconductor material layer comprising a doped first distributed Bragg reflector (DBR), an active layer and a doped second DBR, doped oppositely of the first DBR, the first DBR and the second DBR being stacked in sequence, each of the first and second DBRs including a stack of semiconductor material layers alternately having different refractive indexes, wherein the stack for the VCSEL and the first semiconductor material layer share a portion of the first DBR;

forming a second semiconductor material layer to absorb incident light on the second DBR of the photodetector surrounding the VCSEL;

forming a third semiconductor material layer doped with the same type as the first DBR on the second semiconductor material layer;

etching the third and second semiconductor layers and the second DBR of the photodetector to a predetermined depth which extends a portion of the second DBR, such that the second DBR of the photodetector is partially exposed;

forming a second electrode on the second DBR of the VCSEL, exclusive of a window on the second DBR;

forming a first detecting electrode on the exposed portion of the second DBR of the photodetector; and

forming a second detecting electrode on the third semiconductor material layer to expose a light receiving surface of the third semiconductor material layer.

18. The method of claim 17, wherein the second semiconductor material layer is formed of substantially the same material as that used to form the active layer to have substantially the same thickness as the active layer, and the third semiconductor material layer is formed of substantially the same material as that used to form the first DBR to include a smaller number of layers than the first DBR.

19. The method of claim 14, further comprising forming a coil member over the first lens layer, the coil member comprising at lease one coil layer with a spiral structure and a central opening, and an insulating layer formed of a transparent material to allow transmission of light through the central opening of the coil layer, to protect the coil layer and to electrically insulate the adjacent portions of the coil layer.

20. The method of claim 19, wherein the forming of the coil member comprises:

forming a plurality of coil layers; and

forming the optical path control layer between the coil layers.

21. The method of claim 19, wherein the forming of the optical path control layer comprises forming the hologram as a polarization hologram and the method of manufacturing an optical head further comprises forming a polarization converting layer at the side of the optical path control layer which faces the recording medium, to change the polarization of incident light.

22. The method of claim 19, further comprising:

forming an etching mask having an opening over the coil member, such that a central area of the insulating layer is exposed through the opening;

etching the portion of the insulating layer exposed through the opening to form a second lens having curvature;

removing the etching mask; and

forming a second lens layer over the insulating layer using a material having a higher refractive index than the refractive index of the insulating layer.

23. The method of claim 22, wherein the opening of the etching mask is small enough to apply isotropic etching to the exposed portion of the insulating layer.

24. An optical head for recording and/or reproduction of information on a recording medium, the optical head comprising:

a substrate;

a vertical cavity surface emitting laser (VCSEL) having a plurality of semiconductor material layers formed on the substrate and which emits light along an optical axis transverse to a surface of the substrate;

a photodetector having a plurality of layers of semiconductor material formed on the substrate and sharing at least one semiconductor material layer with the VCSEL;

an optical system formed over the VCSEL and the photodetector which focuses the emitted light onto the recording medium and transmits light reflected from the recording medium to the photodetector.

25. The optical head of claim 24 wherein the photodetector surrounds the optical axis.

26. The optical head of claim 24, wherein the photodetector is offset from the optical axis along the surface of the substrate.

27. The optical head of claim 24, wherein the VCSEL comprises:

a doped first distributed Bragg reflector (DBR) formed by alternately stacking layers of semiconductor material having different refractive indexes,

an active layer formed on the first DBR, and

a second DBR doped oppositely of the first DBR and formed by alternately stacking layers of semiconductor materials having different refractive indexes.

28. The optical head of claim 27, wherein the VCSEL and the photodetector share the semiconductor layers comprising the first DBR.

29. The optical head of claim 24, wherein the photodetector further comprises:

a second active layer formed on the at least one semiconductor material layer which is shared with the VCSEL; and

a second plurality of layers of semiconductor material formed on the second active layer.

30. The optical head of claim 27, wherein the plurality of layers of the photodetector comprises a number of layers of semiconductor material corresponding to the number of layers of semiconductor material of the VCSEL.

31. The optical head of claim 24, wherein the optical system is formed by thin film deposition.

32. The optical head of claim 24, wherein the optical system comprises:

a first lens layer formed on the VCSEL, the first lens layer having a first micro-lens formed thereon which condenses the light emitted by the VCSEL.

33. The optical head of claim 24, where in the micro-lens is formed by etching the formed lens layer.

34. The optical head of claim 32, further comprising:

a second lens layer having a second micro-lens formed thereon which focuses the emitted light on the recording medium.

35. The optical head of claim 34, further comprising a region of transparent material which spaces apart the first micro lens and second micro-lens.

36. The optical head of claim 35, further comprising a control layer having a hologram, the hologram redirecting light reflected from the recording medium to the photodetector.

37. The optical head of claim 36, wherein the photodetector surrounds the VCSEL and the hologram has a concentric pattern.

38. The optical head of claim 35, wherein the photodetector is offset from the optical axis and the hologram has a stripe pattern.

39. A method of making an optical head for recording and/or reproduction of information on a recording medium, the method comprising:

providing a substrate;

forming a vertical cavity surface emitting laser (VCSEL) on the substrate, to emit light along an optical axis transverse to a surface of the substrate;

forming a photodetector on the substrate so that the photodetector and the VCSEL share at least one semiconductor layer; and

forming an optical system over the VCSEL and the photodetector which focuses the emitted light onto the recording medium and transmits light reflected from the recording medium to the photodetector.

40. The method of claim 39, wherein the forming of the VCSEL comprises:

alternately stacking layers of semiconductor material having different refractive indexes on the substrate to form a doped first distributed Bragg reflector (DBR);

forming a first active layer on the first DBR, and

alternately stacking additional layers of semiconductor material having different refractive indexes on the first active layer, to form a second doped DBR, the doping of the second DBR being opposite to the doping of the first DBR.

41. The method of claim 40, wherein the forming of the photodetector comprises:

forming a second active layer on a predetermined area of the second DBR;

forming a third active layer on the second active layer; and

etching the second DBR and the first, second and third active layers to form a trench having a depth which extends into the first DBR, to divide the second DBR into first and second portions, separating the photodetector from the VCSEL.

42. The method of claim 39, wherein the forming of the optical system comprises:

forming a first lens layer on the VCSEL and the photodetector;

forming a mask on the first lens layer, the mask having a central opening which surronds the optical axis; and

etching the first lens layer within the central opening of the mask, to form a first micro-lens.

43. The method of claim 42, wherein the forming of the optical system further comprises:

forming a layer of transparent material on the first micro-lens, the transparent material having a predetermined thickness along the optical axis;

forming another mask on the on a surface of the layer of transparent material, the another mask having another central opening which surrounds the optical axis;

etching the transparent material within the central opening of the another mask, to form a cavity having a shape of a second micro-lens; and

forming a second lens layer on the layer of transparent material, the material forming the second lens layer being shaped by the cavity, to form the second micro-lens.

44. The method of claim 42, wherein the forming of the optical system further comprises:

forming a layer of transparent material on the first micro-lens, the transparent material having a predetermined thickness along the optical axis;

forming an optical control layer on the transparent material, the optical control layer comprising a hologram;

forming another layer of transparent material on the first micro-lens, the transparent material having another predetermined thickness along the optical axis;

forming another mask on a surface of the another layer of transparent material, the another mask having another central opening which surrounds the optical axis;

etching the another layer of transparent material within the another central opening of the another mask, to form a cavity having a shape of a second micro-lens; and

forming a second lens layer on the another layer of transparent material, the material forming the second lens layer being shaped by the cavity, to form the second micro-lens.

45. The method of claim 44 wherein the forming of the control layer comprises forming the hologram to have a concentric pattern.

46. The method of claim 44 wherein the forming of the control layer comprises forming the hologram to have a stripe pattern.

47. The method of claim 44, wherein the method further comprises forming a coil within the layer of transparent material.

48. The method of claim 44, wherein the method further comprises forming a coil within the another layer of transparent material.

49. A method of forming a micro-lens, comprising:

preparing a polymer material having a predetermined thickness and a first refractive index;

depositing a mask on a surface of the polymer material, the mask having an opening of a predetermined area;

isotropically etching the polymer material through the opening, to form a cavity; and

coating at least the cavity with a dielectric material having a second refractive index higher than the first refractive index.

50. A method of forming a micro-lens, comprising:

preparing a lens material having at least one planar surface;

depositing a mask on the surface, the mask having an opening of a predetermined area; and

etching the lens material through the opening.

51. The method of claim 50, wherein the etching is performed by diffusion-limited etching.

52. The method of claim 50, wherein the etching is performed using a solution containing bromine.

53. An optical head for recording and/or reproduction of information on a recording medium, the optical head comprising:

a substrate;

a vertical cavity surface emitting laser (VCSEL) having a plurality of semiconductor layers formed on the substrate and which emits light along an optical axis transverse to a surface of the substrate;

a photodetector formed on the substrate and sharing at least one semiconductor layer with the VCSEL;

an optical system formed over the VCSEL which focuses the emitted light onto the recording medium.

54. The method of claim 53, wherein the optical system comprises a micro lens formed by diffusion-limited etching.

55. The method of claim 53, wherein the optical system comprises a micro lens formed by etching using a solution containing bromine.

56. An optical head for recording and/or reproduction of information on a recording medium, the optical head comprising:

a substrate;

a vertical cavity surface emitting laser (VCSEL) formed on the substrate;

a photodetector formed on the substrate;

an optical system formed over the VCSEL by thin film deposition.

57. The optical head of claim 56 wherein the optical system is further formed over the photodetector.

58. The optical head of claim 57 wherein the photodetector surrounds the VCSEL.

59. The optical head of claim 57, wherein:

the VCSEL emits light along a optical axis transverse to a surface of the substrate; and

the photodetector is offset from the optical axis along the surface of the substrate.